

CLAIMS

What is claimed is:

- 1 1. A method comprising:
2 fabricating at least a thermoelectric film onto a bare wafer;
3 bonding backside of the bare wafer to an active wafer having at least a device;
4 and
5 annealing the bonded bare and active wafers.

- 1 2. The method of claim 1 wherein fabricating comprises:
2 fabricating the at least thermoelectric film made by an alloy comprising at least
3 one of bismuth (Bi), tellurium (Te), antimony (Sb), lead (Pb), silicon (Si), germanium
4 (Ge).

- 1 3. The method of claim 2 wherein fabricating comprises:
2 fabricating the at least thermoelectric film made by the alloy, the alloy
3 comprising one of Bi and Te, Sb and Te, Zn and Sb, Te, Ag, Ge, and Sb, and Pb and
4 Te.

- 1 4. The method of claim 2 wherein fabricating comprises:
2 fabricating the at least thermoelectric film made by the alloy, the alloy being
3 one of Bi_2Te_3 , Sb_2Te_3 .

- 1 5. The method of claim 1 wherein fabricating comprises:
2 fabricating the at least thermoelectric film at a location corresponding to a
3 localized hot spot on the active wafer.

- 1 6. The method of claim 1 wherein bonding further comprises:
2 aligning the bare wafer to the active wafer.

- 1 7. The method of claim 1 further comprising:
2 thinning at least one of the bare wafer and the active wafer before bonding.

- 1 8. The method of claim 1 further comprising:
2 coating the backside of the bare wafer with an interlayer to enhance bonding.

- 1 9. The method of claim 1 wherein annealing comprises:
2 heating the bonded bare and active wafers at a temperature for a time period;
3 and
4 cooling the bonded wafer.
- 1 10. The method of claim 1 further comprising:
2 providing power signal to control at least thermoelectric film.
- 1 11. A wafer assembly comprising:
2 a bare wafer having at least a thermoelectric film fabricated thereon, the bare
3 wafer having a backside; and
4 an active wafer bonded to the bare wafer by the backside, the active wafer
5 having at least an active device; wherein the bonded bare and active wafers being
6 annealed.
- 1 12. The wafer assembly of claim 11 wherein the at least thermoelectric film
2 is made by an alloy comprising at least one of bismuth (Bi), tellurium (Te), antimony
3 (Sb), lead (Pb), silicon (Si), germanium (Ge).
- 1 13. The wafer assembly of claim 12 wherein the alloy comprises one of Bi
2 and Te, Sb and Te, Te, Si, Ge, and Sb, and Pb and Te.
- 1 14. The wafer assembly of claim 12 wherein the alloy is one of Bi_2Te_3 ,
2 Sb_2Te_3 , and Zn_4Sb_3 .
- 1 15. The wafer assembly of claim 11 wherein the at least thermoelectric film
2 is fabricated at a location corresponding to a localized hot spot on the active wafer.
- 1 16. The wafer assembly of claim 11 wherein the active wafer is bonded to
2 the bare wafer in alignment.
- 1 17. The wafer assembly of claim 11 wherein at least one of the bare wafer
2 and the active wafer is thinned.

1 18. The wafer assembly of claim 11 further comprising an interlayer coated
2 at the backside of the bare wafer to enhance bonding.

1 19. The wafer assembly of claim 11 wherein the bonded bare and active
2 wafers is annealed by being heated at a temperature for a time period and cooled from
3 the temperature.

1 20. The wafer assembly of claim 11 wherein the bare wafer has power
2 signal to control the at least thermoelectric film.

1 21. A die assembly comprising:
2 a die having an active device;
3 a substrate bonded to the die; and
4 at least a thermoelectric film fabricated on the substrate to remove heat from the
5 die when the active device is powered.

1 22. The die assembly of claim 21 wherein the at least thermoelectric film is
2 made by an alloy comprising at least one of bismuth (Bi), tellurium (Te), cesium (Cs),
3 zinc (Zn), antimony (Sb), lead (Pb), silver (Ag), germanium (Ge).

1 23. The die assembly of claim 22 wherein the alloy comprises one of Bi and
2 Te, Sb and Te, Zn and Sb, Te, Ag, Ge, and Sb, and Pb and Te.

1 24. The die assembly of claim 22 wherein the alloy is one of Bi_2Te_3 , Sb_2Te_3 ,
2 and Zn_4Sb_3 .

1 25. The die assembly of claim 21 wherein the at least thermoelectric film is
2 fabricated at a location corresponding to a localized hot spot on the active device.

1 26. The die assembly of claim 21 further comprising an interlayer coated at
2 the substrate to enhance bonding.